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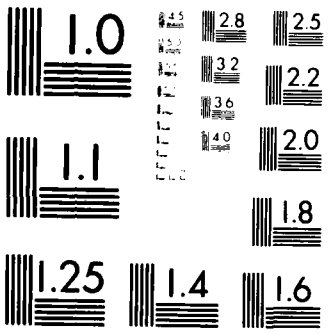

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

AUTOMATED POLYMER DIE ATTACH MACHINE

HUGHES AIRCRAFT COMPANY
TUCSON MANUFACTURING DIVISION

HUGHES
HUGHES AIRCRAFT COMPANY

AD-A152 108

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Prepared for:
U.S. Army Missile Command
System Engineering Directorate
ATTN: DRMSI-RHS
Redstone Arsenal, 35898

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Report DAAH01-81-D-A001

AUTOMATED POLYMER DIE ATTACH MACHINE

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Hughes Aircraft Company
Tucson Manufacturing Division
P. O. Box 11337
Tucson, AZ 85734

13 January 1981

Initial Report

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DAAH01-81-D-A001	2. GOVT ACCESSION NO. AD-A1152 16
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): AUTOMATED POLYMER DIE ATTACH MACHINE	5. TYPE OF REPORT & PERIOD COVERED: Initial, 1/13/81
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): G.M. Coppus/G. N. Hunter	8. CONTRACT OR GRANT NUMBER(s): DAAH01-81-D-A002
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Hughes Aircraft Company, Tucson Manufacturing Division, P. O. Box 11337 Tucson, AZ 85734	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: PAN: 7RY11
11. CONTROLLING OFFICE NAME AND ADDRESS: U. S. Army Missile Command, System Engineering Directorate, ATTN: DRSMI-RHS Redstone Arsenal, AL 35898	12. REPORT DATE: 13 January 1981
	13. NUMBER OF PAGES: 8
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Automatic Die Attachment; Hybrids, Polymer Die Attachment, Die Recognition Systems; Robotics.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report which follows specifies the program plan, technical plan and statement of work associated with the development and construction of an automated polymer die attach machine for subsequent utilization in a high rate manufacturing environment.

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TECHNICAL REQUIREMENT

Automated Polymer Die Attach Machine

1.0 General

The current trend throughout the military hybrid industry is the reduction of operator controlled variables in an effort to reduce cost while maintaining or increasing equipment volume handling capability. An important area in which this can be accomplished is in the chip to substrate assembly operation. Existing equipment is designed for operator recognition and orientation alingment of individual semiconductor chip topographies. The purpose of this manufacturing technology program is to develop a semi-automatic chip recognition Die Bonding System. The system must present a video image of the die to be placed on a TV Monitor. This image shall be overlayed with an outline image of the die to show correct orientation of said die. The operator will then align this overlayed image to the real die. The machine will then pick up, orient, and place the die in correct orientation on the substrate without operator control. This system must be applicable to a future fully automatic hybrid die bonder.

2.0 Applicable Documents

2.1 MIL-STD-883

2.2 MIL-M-38510

3.0 Requirements

3.1 Technical Effort

The contractor shall provide the personnel, materials, equipment, and expertise required to perform the tasks hereinafter required.

3.2 Planning

The technical effort to be conducted under these requirements will be planned in terms of technical tasks and related objectives to be accomplished in the pursuit of the entire program. Each task and related objective will result in the completion of a significant portion of the total effort. The following outline describes these aforementioned tasks and objectives and a milestone chart for completion of the outlined items is included in the program plan portion of this report.

I. System Analysis

A. Mechanical Design - Mechanical requirements/capabilities specification:

1. Die Pickup - vacuum system
   - detection of pickup
   - pickup tools
2. Pickup Arm Motion/Motor Drive
3. X-Y Table Motion/Motor Drive
4. Waffle Pack Tooling
5. Vibratory Feeder Tooling
6. Work (Substrate) Holder Tooling
7. Substrate Magazine

B. Video Augmentation Design - Optical requirements/capabilities specification:

1. Camera
2. CCTV Monitor
3. Lighting

C. Electrical Hardware Design - Circuitry requirements/capabilities specification and packaging constraints.

D. Sofware Design - Capacity requirements/capabilities specification:

NOTE: The plan for accomplishing the System Analysis and their objectives will include but not be limited to:

1) Task/Objective Definition
2) Accuracy and Resolution Requirements
3) Generation of Interfacial Requirements

II. Mechanical Design - this phase shall occur subsequent to the System Analysis phase and result in implementation of all system requirements, capabilities, and constraints that are developed during the course of the Systems Analysis. The individual items to undergo design shall be identical to the line items outlined under Section I, of this outline, System Analysis but will be consolidated into:

A. Die Pickup/Pickup Arm
B. Part Presentation Tooling
C. X-Y Table/Workholder
D. Substrate Magazine

III. Video Augmentation - This phase shall also occur subsequent to the System Analysis phase and results in, again, the implementation of all systems requirements, capabilities and constraints that are developed during the course of the Systems Analysis.

IV. Hardware/Software Design - Tie in of individual components:

A. Hardware
B. Software

} With respect to both hardware and software the aforementioned mechanical and video designs of individual components shall be integrated resulting in full-up subsystem design development and associated packaging.

V. Final Design (Prototype) - in this last phase of development the previously mentioned Hardware/Software subsystems shall be packaged into a final unit concept which will be subsequently assembled into a working prototype allowing performance evaluation of the individual components and subsystems.

The plan for performance of Sections II through V identified above shall include but not be limited to:

1) Performance - specification generation
2) Drawing development
3) Components and Materials selection
4) Procurement of vended components and materials.

3.3 Description of Effort to be Performed

3.3.1 General Description

The hybrid die bonder is to be a semi-automatic computer-controlled system for attaching semiconductor die components to ceramic substrates. The dies are bonded to the substrate by utilizing pre-screened epoxy. The system will be composed of a pick and place arm, a substrate workholder with automatic substrate feed from magazines and an array of up to forty-two 2 x 2 inch waffle packs or a combination of waffle packs and linear vibratory chip feeders.

In operation, a substrate is automatically fed by the workholder from the magazine to the bond site and clamped into position. The position of the substrate is aligned to crosshairs on a CCTV monitor. Following pretaught instructions, the computer will direct the pick and place arm to the proper waffle pack where the next available die is displayed on the monitor. The amount of die misalignment and its orientation is determined by image correlation techniques. The die is

then picked up and placed in its proper orientation on the substrate. This cycle will continue until the substrate has been completely bonded. The substrate is then fed into the output magazine and replaced by a new one and the process continues. The computer monitors the number of die in each waffle pack or feeder and will signal via the CCTV monitor when a waffle pack must be replaced or feeder refilled. Waffle pack trays and feeders slide out from under the machine cover to allow the operator to quickly replace or refill them. When all substrates have been completed, the system automatically stops.

3.3.2 Alignment Accuracy

The chip recognition system shall be capable of positioning components within $\pm$ .002 inches of the exact position and within $\pm$ 5 degrees of the exact orientation.

3.3.3 Production Rates

The semi-automatic system must have a through-put of 25 or more substrates per hour with approximately 30 dies per substrate.

3.3.4 Configuration

3.3.4.1 Overall Dimensions

The system size will be approximately 48 inches wide x 36 inches deep x 50 inches high or less and will occupy floor space of approximately 48 inches wide x 48 inches deep or less.

3.3.4.2 Substrate Feed

Substrates must be fed automatically from magazines or equivalent and cycle at approximately two (2) seconds or less.

3.3.4.3 Waffle Pack Capacity

The system must accommodate approximately forty-two (42) 2 x 2 inch waffle packs (Flourware type or equivalent) from which die may be selected.

3.3.4.4 Vibratory Chip Feeder

The system must provide for up to eight chip feeders. The maximum number of waffle packs (3.3.4.3) may be reduced to thirty-six (36) if eight feeders are configured.

3.3.5 Other Requirements

The system shall not subject the substrate to temperatures in excess of 100°F. The system shall not damage devices being attached to substrates. The system shall have an emergency stop capability.

4.0 Documentation

4.1 The contractor shall prepare a final report detailing the investigations, tests, and data collected during the course of this project. Data to be delivered, schedule of delivery, and distribution requirements are specified on DD Form 1423. The final report shall contain an outline of the work performed, a general description of the developed manufacturing equipment (with references), a technical description of the process; and shall contain all the material, either within the reports or within the references required to duplicate the equipment and technology. Other reports required shall be as listed on DD Form 1423.

4.2 The contractor shall propose, to the Government, an implementation plan which details the steps to be taken by the contractor to implement the results of this effort. The implementation plan shall cover those facilities owned and/or operated by the contractor and those subcontracted facilities participating in this contract. The primary emphasis of the implementation plan shall be Army Missile Systems and end items/components of Army Missile Systems currently under development or production by the contractor. Data as to the applicability of this project's results to Air Force and/or Navy development/production efforts is also of importance and shall be addressed in the implementation plan.

4.3 The contractor shall provide a 10 minute narrated video tape, and a set of fifty (50) 35mm color slides depicting the manufacturing process, suitable as a familiarization and instructional tool. The determination on the exact content and method shall be by the contractor with Government approval. Delivery shall be at the conclusion of the contract.

4.4 The contractor shall orally review the progress of the work to the Government at quarterly intervals, at mutually agreeable times and places. Other reviews, if determined necessary by the Government, shall not exceed three (3) per year.

4.5 The contractor shall perform an industry demonstration. The contractor shall give the Government sixty (60) days notice prior to demonstration.

Program Plan for Tasks Concerning Automated Polymer Die Attach Machine

1.0 General

This program plan identifies the work to be completed during the performance of MICOM Project #3219, "Automated Polymer Die Attach Machine". The majority of work completed shall occur at Kulicke and Soffa (K & S), equipment manufacturer, with Hughes Aircraft in an overseers capacity ultimately resulting in buy-off of system concept and prototype performance as identified in the Technical Requirements sections of this report.

2.0 Milestones

The attached chart displays the major items to be completed, the time required and the sequence of events of each.

HUGHES

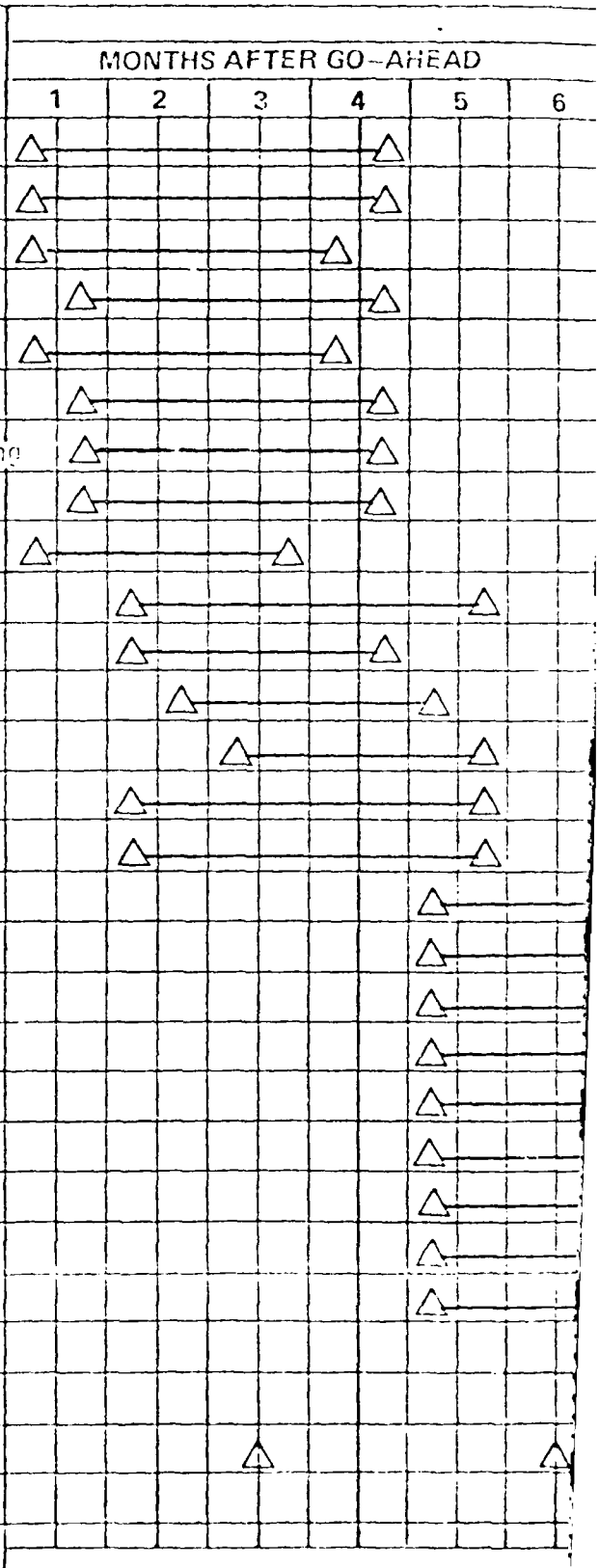
PROGRAM NO. _____ PROGRAM TITLE _____ MICOM PROJECT NO. 3219

WBS ITEM NOMENCLATURE

DESCRIPTION: AUTOMATED POLYMER DIE ATTAC

WBS LEVEL ___ COST ACCT. NO. _____

CRG RESP.	CL OF BUS.	ACTIVITY/EVENT DESCRIPTION
	I	System Analysis
		A. Mech Design Analysis
		1. Die Pickup
		2. Pickup Arm
		3. X-Y Table
		4. Waffle Pack Tooling
		5. Vibratory Feeder Tooling
		6. Workholder Tooling
		7. Substrate Magazine
		B. Video Augmentation Design
		1. Camera
		2. CCTV Monitor
		3. Lighting
		C. Electrical Hdwr. Design
		D. Software Design
	II	Mechanical Design
		A. Die Pickup/Pickup Arm
		B. Part Presentation Tooling
		C. X-Y Table/Workholder
		D. Substrate Magazine
	III	Video Augmentation
	IV	Hardware/Software Design
		A. Hardware
		B. Software
	V	Final Design (Prototype)
		Reporting
		Film



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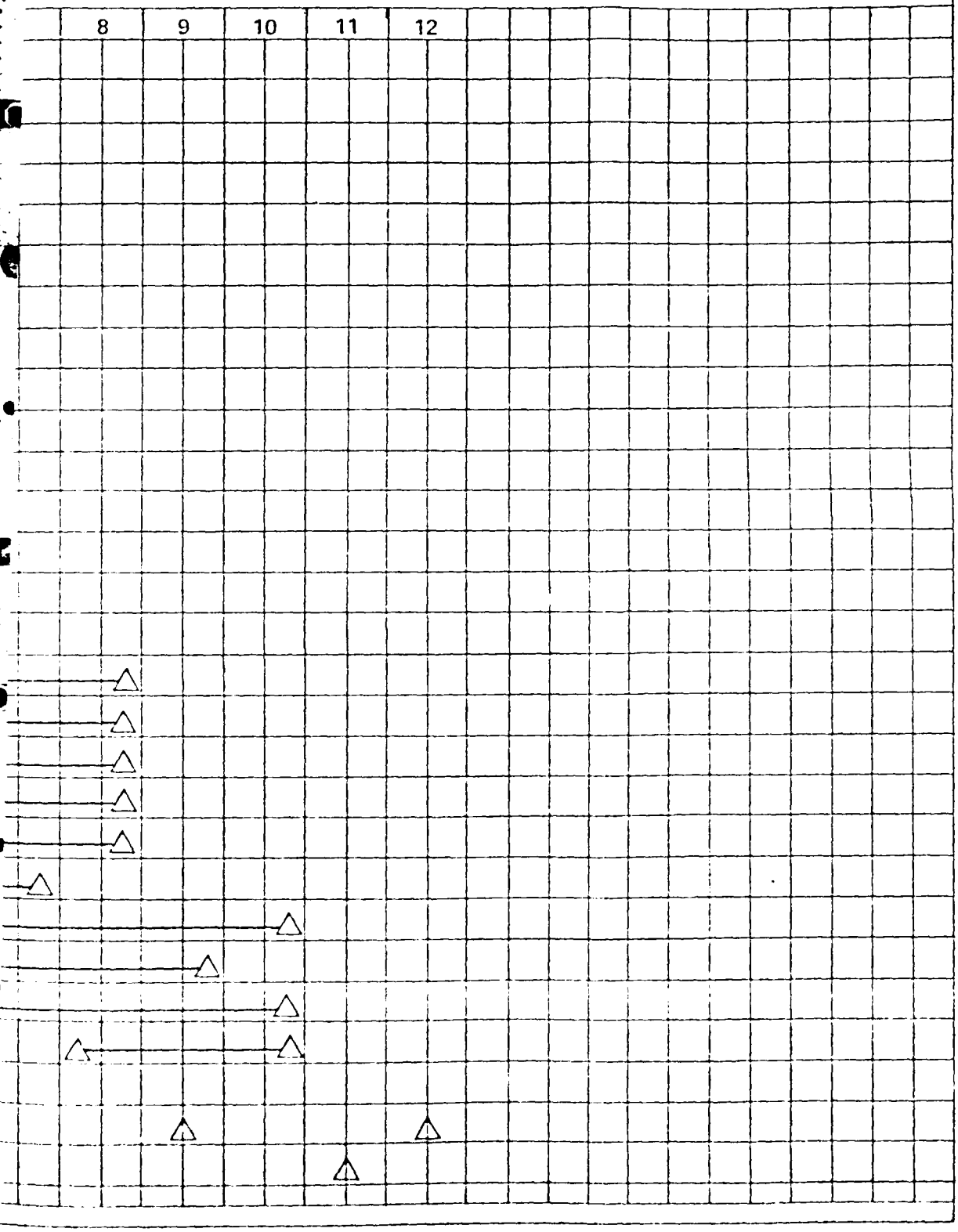

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